

	<p>KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0 July 2013</p>

KPC

QASR COMPRESSION STATION PROJECT



HAZID REPORT

0	12-07-2013	ISSUED FOR APPROVAL	FB	NM	MGR
REV	DATE	DESCRIPTION	BY	CH'D	APP'D

	<p>KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
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SUMMARY

1	INTRODUCTION AND SCOPE.....	3
1.1	GENERAL PROJECT DESCRIPTION.....	3
1.2	SCOPE OF THE HAZID.....	3
2	LIST OF DEFINITIONS AND ACRONYMS.....	5
2.1	DEFINITIONS.....	5
2.2	ACRONYMS.....	5
3	HAZID REVIEW METHODOLOGY.....	6
4	WORKING DOCUMENTATION.....	8
5	HAZID TEAM.....	9
6	HAZID NODES IDENTIFICATION.....	10
7	HAZID ACTIONS.....	11
	ATTACHMENT A - PROCEDURE FOR HAZID STUDY.....	12
	ATTACHMENT B – ATTENDANCE LIST.....	13
	ATTACHMENT C – HAZID WORKSHEETS.....	14
	ATTACHMENT D – HAZID ACTION LIST.....	15

	<p>KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0 July 2013</p>

1 INTRODUCTION AND SCOPE

1.1 GENERAL PROJECT DESCRIPTION

Qasr is a large, normally pressured gas-condensate reservoir located in the Western Desert of Egypt approximately 525 km west of Cairo. The field is operated by Khalda Petroleum Company (KPC), a joint venture between Apache Corporation and Egyptian General Petroleum Company (EGPC).



Field production is initially handled at the Start of Line (SOL) Qasr Plant. After initial treatment (cooling and water removal) the gas/condensate is exported to a combination of the Salam, Tarek and Obaiyed gas plants for further treatment. The Qasr gas and condensate currently free flows from the wellheads through the Qasr Phase I and Phase II facilities and export pipelines to the SHAMS manifold and Salam gas plant under reservoir pressure. As the reservoir pressure declines the peak gas rate of 800 mmscfd will no longer be achievable. The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline. The Qasr Compression Project scope comprises:

- Gas turbine driven single stage compressor sets
- Condensate export pumps
- Utility systems

1.2 SCOPE OF THE HAZID

The HAZID Study performed for the new parts included in the project, was held in ENPPI offices in Cairo, Egypt, on July 9, 10, 11, 2013.

HAZID review is a structured check-list-based risk identification and analysis methodology that enables documented hazard identification of a project in its earliest phase. The hazard checklist used for the study is included in HAZID procedure presented in **Attachment A**.



	<p>KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0 July 2013</p>

The main objective of the HAZID is to undertake the review early during the design step to identify key issues for problem resolution. This is done by the systematic identification of any hazards/aspects (“threats”), which may have the potential to cause harm to workers, damages to equipment, environmental impact or loss of production, followed by a review of whether adequate safeguards exist, or whether additional safeguards are required to mitigate the potential consequences (“actions”).

Risk related to each item that required an action has been ranked according to the severity/probability matrix included in the methodology (refer to par. # 3).

The review shall address all project areas and concentrate on PFD and Plot Plans in early development. The result from the review is documented in the worksheets (**Attachment C**) where potential hazards, their causes and consequences are presented in conjunction to the safeguards in place and recommendations arising from the review.

The list of the HAZID actions is given in **Attachment D**.

	<p align="center">KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p align="center">Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT</p> <p>DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0</p> <p>July 2013</p>


2 LIST OF DEFINITIONS AND ACRONYMS

2.1 DEFINITIONS

COMPANY	KPC
PROJECT	QASR Compression
CONTRACTOR	ENPPI
CONSULTANT	The party which will perform the study (ICARO)

2.2 ACRONYMS

ALARP	As Low As Reasonably Practicable
ESD	Emergency Shutdown
EDG	Emergency Diesel Generator
FEED	Front End Engineering Design
F&G	Fire and Gas detection system
FF	Fire Fighting
HAZID	Hazard Identification Analysis
HAZOP	Hazard and Operability Analysis
HC(s)	Hydrocarbon(s)
HSE	Health, Safety & Environment
MDMT	Minimum Material Design Temperature
Mmscfd	Millions square feet per day
N/A	Not applicable
P&ID	Piping and Instrumentation Diagram
PFD	Process Flow Diagram
PPE	Personal Protective Equipment
RAM	Reliability; Accessibility, Maintainability
SIL	Safety Integrity Level
SOL	Start Of Line
UFD	Utility Flow Diagram

	KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY	ICARO
Project n° 3538-200	DOCUMENT TITLE: HAZID REPORT DOCUMENT NUMBER: 13183I-002	Rev. No.: 0 July 2013

3 HAZID REVIEW METHODOLOGY



The reference HAZID methodology is described in doc. 13183-001 -("PROCEDURE FOR HAZID STUDY"). Such a document is fully reported on **Attachment A**.

In particular, that process consists in arising all potential scenarios having impact on safety by applying some specific guidewords. For each scenario safeguards provided by the design are listed and check if suitable to prevent / mitigate risk arised; otherwise additional safeguards / improvements are required.

The tool to evaluate the need of further improvements is represented by a matrix based semi-quantitative risk assessment, performed for each scenario that required an action, according to criteria defined on the following matrix:

EVENT PROBABILITIES	CONSEQUENCE CATEGORIES		
	1 MINOR ¹	2 MAJOR ¹	3 CATASTROPHIC ¹
D – Frequent. One or more occurrence per year in company	3 HIGH RISK	3 HIGH RISK	3 HIGH RISK
C – Occasional. Incident has occurred in Company	2 MEDIUM RISK	3 HIGH RISK	3 HIGH RISK
B – Remote. Incident has occurred in Exploration & Production Industry	1 LOW RISK	2 MEDIUM RISK	3 HIGH RISK
A – Unlike. Possible but very rare in Exploration & Production Industry	1 LOW RISK	1 LOW RISK	2 MEDIUM RISK
(1) Definon of consequence category is given in table 2			



Table 1 – Risk ranking matrix

	KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY	
Project n° 3538-200	DOCUMENT TITLE: HAZID REPORT	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-002	July 2013

Detailed definitions for each class of damage: people (P), assets (A), environment (E) are given in the following table 2.

DAMAGES	CONSEQUENCE CATEGORIES ¹		
	1 MINOR	2 MAJOR	3 CATASTROPHIC
(P) People damage	Injury	Single fatality	Multiple fatality
(A) Assett damage (material/production losses)	Localized damage. Localized damage to equipment. Production time lost less than one day.	Major damage. Damage extending to several areas, significant impairment of installation and equipment. Production time lost less than one month.	Extensive damage (e.g. uncontrolled fire/explosion) or loss of installation. Production time lost more than one day.
(E) Enironmental damage	Localized impact. Insignificant cost for clean-up and recovery.	Major impact. Substantial cost for clean-up and recovery.	Massive impact. Significant cost for clean-up and recovery.
(1) Based on the hazard scenario consequence estimation, the worst (P) (A) (E) consequence category is selected for risk ranking purpose (see table 1)			


Table 2 – Definition and ranking of (P) (A) (E) damage categories

	<p align="center">KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p align="center">Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT</p> <p>DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0</p> <p>July 2013</p>

4 WORKING DOCUMENTATION

Reference documentation used as a reference during HAZID review is listed here below.

- Plot Plans;
- Process Flow Diagrams;
- Utility Flow Diagrams;
- Design Basis;
- Fire fighting systems design philosophy;
- Fire&Gas detection systems design philosophy;
- ESD system design philosophy;

	<p align="center">KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p align="center">Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT</p> <p>DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0</p> <p>July 2013</p>

5 HAZID TEAM



HAZID review is a multi-disciplinary analysis that requires all team members to bring specific knowledge continuously throughout the session, having the main goal to properly answer any HSE related question, avoiding as much as possible to delay the issue by reporting to people outside of the team.

The composition of the team includes the following experts:

- HAZID Chairman;
- HAZID Secretary;
- HSE Engineers;
- Process Engineers;
- Process/Operation specialists;
- Construction Engineers (on call);
- Lay-out & piping Engineers (on call);
- Instrument Engineers (on call);
- Mechanical / maintenance Engineers (on call);
- KPC representatives.

The HAZID Study performed for the SP19 development phase was held in ENPPI offices in Cairo, Egypt, on July, 9, 10, 11, 2013.



List of attendance for each session is provided on **Attachment B**.

	<p>KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0 July 2013</p>

6 HAZID NODES IDENTIFICATION

According to the characteristics of the project, during the analysis the team agreed to consider only a single node, including all the new systems, as a reference item to be processed by HAZID.



Detailed HAZID worksheets are provided on **Attachment C**.

	<p>KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0 July 2013</p>

7 HAZID ACTIONS

An overall number of 43 actions has been raised from HAZID.

Action list is provided on **Attachment D**.

	<p>KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0 July 2013</p>

ATTACHMENT A - PROCEDURE FOR HAZID STUDY



ICARO

Project n° 3538-200

PO n. 3538-200-10-RT-042-5



Doc. N° 131831-001

KPC

QASR COMPRESSION STATION PROJECT



PROCEDURE FOR HAZID STUDY

0	04-07-2013	ISSUED FOR APPROVAL	FB	NM	MGR
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	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p> <p>DOCUMENT NUMBER: 13183I-001</p>	<p>Rev. No.: 0</p> <p>July 2013</p>

SUMMARY

1	INTRODUCTION	4
1.1	General project description	4
1.2	Scope	5
1.3	List of definitions and abbreviations	6
1.3.1	Definitions.....	6
1.3.2	Abbreviations.....	6
1.4	References	7
2	HAZID METHODOLOGY	8
2.1	Styles of HAZID	8
2.2	FEED HAZID	8
3	PARTICIPANTS.....	10
4	COORDINATOR (Chairman)	11
5	PREPARATION	12
6	REVIEW PROCEDURE	13
7	DEFINITIONS OF HSE TERMS.....	14
7.1	Threats	14
7.2	Consequences.....	14
7.3	Existing Safeguards.....	14
7.4	Ranking	14
7.5	Action.....	14

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001	July 2013

8	STUDY PROCEDURE	15
8.1	Overview.....	15
8.2	Global Study Methodology	15
8.3	Plant Areas (Nodes).....	16
8.4	Areas (Node) Study Methodology	16
8.5	Brainstorming & Analysis	17
8.6	Operating Modes & Life Cycle Issue	19
9	RISK RANKING	20
10	RECORDING & REPORTING	22
11	HAZID CHECK LIST.....	22

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p> <p>DOCUMENT NUMBER: 13183I-001</p>	<p>Rev. No.: 0</p> <p>July 2013</p>



1 INTRODUCTION

1.1 General project description

Qasr is a large, normally pressured gas-condensate reservoir located in the Western Desert of Egypt approximately 525 km west of Cairo. The field is operated by Khalda Petroleum Company (KPC), a joint venture between Apache Corporation and Egyptian General Petroleum Company (EGPC).

Field production is initially handled at the Start of Line (SOL) Qasr Plant. After initial treatment (cooling and water removal) the gas/condensate is exported to a combination of the Salam, Tarek and Obaiyed gas plants for further treatment. The Qasr gas and condensate currently free flows from the wellheads through the Qasr Phase I and Phase II facilities and export pipelines to the SHAMS manifold and Salam gas plant under reservoir pressure. As the reservoir pressure declines the peak gas rate of 800 mmscfd will no longer be achievable. The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline. The Qasr Compression Project scope comprises:

- Gas turbine driven single stage compressor sets;
- Condensate export pumps;
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	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p> <p>DOCUMENT NUMBER: 13183I-001</p>	<p>Rev. No.: 0</p> <p>July 2013</p>

1.2 Scope

The purpose of this document is to describe the methodology for conducting and recording a Hazard Identification Analysis (HAZID). The HAZID is a technique for early identification of potential Safety and Environmental hazards to permit prevention, and should this not be possible, mitigation methods to be implemented into the design to ensure the perceived risks are As Low As Reasonably Practicable (ALARP).

When implemented at the correct phase of the project, such modifications can have minimum cost / schedule implications and can often prove to be cost beneficial by identifying a case for analyzing the reduction, of say active or passive fire protection systems.

The HAZID will use as reference available engineering document in particular the Process Flow Diagrams (PFD), the plot plan, and the Process and Utilities Basis of Design.

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001	July 2013



1.3 List of definitions and abbreviations

1.3.1 Definitions

COMPANY	KPC
PROJECT	QASR Compression
CONTRACTOR	ENPPI
CONSULTANT	The party which will perform the study (ICARO)



1.3.2 Abbreviations

ALARP	As Low As Reasonably Practicable
ESD	Emergency Shutdown
HAZID	Hazard Identification Analysis
HAZOP	Hazard and Operability Analysis
HSE	Health, Safety & Environment
FEED	Front End Engineering Design
PFD	Process Flow Diagram
P&ID	Piping and Instrumentation Diagram
SOL	Start Of Line
UFD	Utility Flow Diagram

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001	July 2013

1.4 References

- HAZID SCOPE OF WORK doc. N° 3538-200-10-RT-042
- PROJECT PFDs & PLOT PLANS
- PROCESS AND UTILITIES BASIS OF DESIGN doc. N° 3538-200-ACA-01
- CONTROL, SHUTDOWN AND PROCESS SAFEGUARDING PHILOSOPHY doc. N° 3538-200-10-RT-001
- FLARE, BLOWDOWN AND VENT PHILOSOPHY doc. N° 3538-200-10-RT-004

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p>	<p>Rev. No.: 0</p>
	<p>DOCUMENT NUMBER: 13183I-001</p>	<p>July 2013</p>

2 HAZID METHODOLOGY

2.1 Styles of HAZID

The balance between holding a study early enough to affect major decisions but late enough to have allowed the accumulation of sufficient information to undertake a meaningful review has led to two styles of studies:

1. Conceptual HAZID
2. FEED HAZID.



The choice between the two is made taking into consideration the status of the project at the moment when the study is performed and the status of relevant documentation.

For the KPC – QASR Compression Project Project the methodology will be to conduct a FEED analysis as described below.

2.2 FEED HAZID

This level of analysis is designed for use, once the single or competing process options have been developed to the point where process flow schemes, material balances, design philosophy, equipment list and plot plans are available for review.



At this point the HSE comprehension of the project design should be able to identify the predominant hazards. Given this level of information the analysis can consider both the broader external and internal hazards as well as intimate hazards associated with the process and utility services.

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p>	<p>Rev. No.: 0</p>
	<p>DOCUMENT NUMBER: 13183I-001</p>	<p>July 2013</p>

They are therefore able to review the initial engineering decisions on:

- Process technology,
- Capacities,
- Sparing philosophy,
- Operations concept,
- Layout consideration,
- Prevention of escalation, containment, protection, isolation, etc.

This study is based on a review of the HAZID checklist as APPENDIX 1.

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p>	<p>Rev. No.: 0</p>
	<p>DOCUMENT NUMBER: 13183I-001</p>	<p>July 2013</p>



3 PARTICIPANTS

In a desktop type study the participants are kept to a minimum whilst still ensuring a thorough effective review. It is proposed to use the following review participants on this HAZID:

- An independent HSE engineer who is not directly working on the project to provide an impartial view on the project design, to coordinate the HAZIP review (“Coordinator”).
- A scribe, to record the analysis during the meeting.

The following specialists to be contacted on an as required basis:



- A project HSE Engineer
- A project Process Engineer,
- Layouts & Piping Engineer,
- Construction Engineer,
- Mechanical engineer,
- Electrical engineer,
- Instrumentation engineer,
- Civil/Structural engineer etc.

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001	July 2013

4 COORDINATOR (CHAIRMAN)

In common with other structured brainstorming and review studies, the role of the Coordinator is critical to the success of the review. He/She will be responsible to:



- Lead the participants through the HAZID technique,
- Prompt the brainstorming effort,
- Manage the discussion without compromising the creativity of the process,
- Identify the key issues as they are raised by the participants,
- Record the findings ensuring that the minutes fully reflect the points identified,
- The Coordinator needs to recognize the HSE issues as they are raised. To do this He/She needs to have wide ranging technical expertise applicable to the type of development under review.

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p>	<p>Rev. No.: 0</p>
	<p>DOCUMENT NUMBER: 13183I-001</p>	<p>July 2013</p>

5 PREPARATION

The project now has a significant number of documentation that can be used to conduct the HAZID review. It is proposed that the following documentation will be available to the participants during the review.



- Process Block diagram,
- Mass balance information,
- Plot plan layouts,
- PFD's,
- Equipment lists.

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p>	<p>Rev. No.: 0</p>
	<p>DOCUMENT NUMBER: 13183I-001</p>	<p>July 2013</p>

6 REVIEW PROCEDURE

It is essential to conduct the review in a structured and systematic manner. Typically it is normal to start with the plot plans and then review the other documents mentioned above, as and when necessary, to gain a comprehensive overview of the scheme proposed.

The process engineer kicks off the meeting by summarizing the process description to give a process overview of the plant purpose and configuration and its normal operating condition. The description is referred to alternative operating cases, life cycle issues and planned plant flexibility, operating philosophy and product take-off constraints.

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p> <p>DOCUMENT NUMBER: 13183I-001</p>	<p>Rev. No.: 0</p> <p>July 2013</p>

7 DEFINITIONS OF HSE TERMS

The general terms of reference should be understood by all participating members these being:

7.1 Threats

These are defined as having the potential to cause harm, including ill health and injury, damage to property, production losses or increased liabilities.

7.2 Consequences

These are possible consequences that could occur from the threats, potentially release the hazard to produce an incident, and include the residual effects.

7.3 Existing Safeguards



These are mechanisms that are intended to prevent the release of the hazard.

7.4 Ranking

A ranking of High, Medium or Low is to be allocated to the identified risk to help the actionees in prioritizing their efforts to achieve a resolution.

7.5 Action

Although not compulsory the participants can propose solutions if they have very strong convictions as to how a solution can be achieved. Alternatively this column can be used to describes what action needs to be taken to resolve the identified risk.

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001	July 2013

8 STUDY PROCEDURE

8.1 Overview

Many of the hazards and HSE issues are generic for the whole development and are not specific to any part of the plant or location. The preferred procedure is therefore, firstly to apply the technique to the whole development as a single entity, and then review discrete Unit or area as appropriate.



It is intended to record by exception, namely hazards that are considered but are not found to be present will not be recorded. The identified hazards will be entered into the HAZOP Report documents.

8.2 Global Study Methodology

The study method is a combination of identification, analysis and brainstorming based on the hazards identified on the checklist.

Sections that contain global hazards and project implementation issues, which may be covered once for the whole development, are:

- External and Environmental Hazards,
- Health Hazards,
- Project Implementation Issues,
- Security hazards.

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>		
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p>		<p>Rev. No.: 0</p>
	<p>DOCUMENT NUMBER: 13183I-001</p>		<p>July 2013</p>

8.3 Plant Areas (Nodes)

Once all the global issues have been discussed, the participants should break down the development into a number of clearly defined areas. These areas will then be examined in turn to identify issues that have a specific impact on each location within the development. The definition of an area will usually be either a geographical location, for a development consisting of several plant items or buildings, or each major process group/functional area (a UNIT).



For example one node could be "compressor & export system" where the guidewords would be applied to consider the effects of inventory control or release, potential escalation, maintenance hazards, etc.

In the following table the list of nodes to be submitted to HAZID review.

Ref. n.	Description
1	Overall plant
2	Compressor & export system
3	Condensate handling system
4	Instrument & utility air system
5	Nitrogen generation system
6	Closed drain system
7	Potable water system
8	Sanitary sewage collection

8.4 Areas (Node) Study Methodology

Once the Coordinator has identified the "node" to be studied, which could range from the several plants to a discrete item of plant, the function of that node will be discussed and agreed by the participants and then recorded. The Coordinator will then examine the node against the Checklist and within each Checklist section adopt the following procedure:

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p> <p>DOCUMENT NUMBER: 13183I-001</p>	<p>Rev. No.: 0</p> <p>July 2013</p>

- The Coordinator will nominate a category from the checklist and then ask the participants to consider each guideword,
- In each case the participants will analyze each guideword (helped by the examples given in the Checklist) to identify any hazard and its potential effects which may then be entered on the worksheet,
- The brainstorming process will then be used to identify all the potential threats or causes of the hazard. During this process the Coordinator may suggest examples from the "expanders" section of the checklist. It is important however that these expanders are suggested as examples and not presented as a closed list which will restrict the participants brainstorming activity,
- The participants will analyze the appropriate controls that typically should be in place to prevent or control each threat. At this point the participants may suggest additional solutions to mitigate the residual risk,
- Finally the participants will identify the initial ranking for the risk without the additional solutions.



Note, the HAZID Checklist is comprehensive but not exhaustive and the use of brainstorming to identify novel or unforeseen sources may be required.

8.5 Brainstorming & Analysis



The participant's knowledge and creativity should be used to identify credible causes and the relevant applicability of the hazards. It is important that the list of hazards is used in a creative manner and not as a rigid checklist. It is only in this way that new or unusual hazards will be recognized, or where specific combinations of factors will be identified as causes of concern.

The process for the brainstorming can best be described as:

- Select plant area / node,
- From the checklist select the category,
- Against each guideword check if the hazard possible / likely,
- If "no" note (but not record) and move onto the next guideword,



	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p> <p>DOCUMENT NUMBER: 13183I-001</p>	<p>Rev. No.: 0</p> <p>July 2013</p>

- If "yes" by means of brainstorming identify all the threats their causes and consequences,
- Identify what existing safeguards are in place,
- Assess what additional controls or barriers are required to prevent or control the effect.

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001	July 2013

8.6 Operating Modes & Life Cycle Issue

The study will concentrate on the normal operating mode (design case) of the plant, but where possible alternative operating modes, e.g. start-up, shutdown, ESD and blow-down, etc will be considered. If practicable the study participants should consider all the phases of the development from design and construction through to eventual abandonment. Many hazards are only relevant to unique project phases or become apparent at different stages of the life cycle of the plant development and where this is identified it will be discreetly recorded on the Recording Register APPENDIX 2.

	KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY	
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001	July 2013

9 RISK RANKING

The tool to evaluate the need of further improvements is represented by a matrix based semi-quantitative risk assessment, performed for each scenario that required an action. Such risk ranking is obtained by combining event probabilities and consequences. Event probabilities were defined as:

- A – Unlike
- B – Remote
- C – Occasional
- D – Frequent



Damages / consequences categories were distinguished in:

- 1 – Minor
- 2 – Major
- 3 – Catastrophic

Detailed definitions for each class of damage: people (P), assets (A), environment (E) are given in the following “table 1”.

DAMAGES	CONSEQUENCE CATEGORIES ¹		
	1 MINOR	2 MAJOR	3 CATASTROPHIC
(P) People damage	Injury	Single fatality	Multiple fatality
(A) Assett damage (material/production losses)	Localized damage. Localized damage to equipment. Production time lost less than one day.	Major damage. Damage extending to several areas, significant impairment of installation and equipment. Production time lost less than one month.	Extensive damage (e.g. uncontrolled fire/explosion) or loss of installation. Production time lost more than one day.
(E) Enironmental damage	Localized impact. Insignificant cost for clean-up and recovery.	Major impact. Substantial cost for clean-up and recovery.	Massive impact. Significant cost for clean-up and recovery.
(1) Based on the hazard scenario consequence estimation, the worst (P) (A) (E) consequence category is selected for risk ranking purpose (see table 2)			



Table 1 – Definition and ranking of (P) (A) (E) damage categories

	KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY	
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001	July 2013

The combined risk may be obtained by crossing event probability and consequence category according to the following “table 2”.

EVENT PROBABILITIES	CONSEQUENCE CATEGORIES		
	1 MINOR ¹	2 MAJOR ¹	3 CATASTROPHIC ¹
D – Frequent. One or more occurrence per year in company	3 HIGH RISK	3 HIGH RISK	3 HIGH RISK
C – Occasional. Incident has occurred in Company	2 MEDIUM RISK	3 HIGH RISK	3 HIGH RISK
B – Remote. Incident has occurred in Exploration & Production Industry	1 LOW RISK	2 MEDIUM RISK	3 HIGH RISK
A – Unlike. Possible but very rare in Exploration & Production Industry	1 LOW RISK	1 LOW RISK	2 MEDIUM RISK
(1) Definition of consequence category is given in table 1			

Table 2 – Risk ranking matrix

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p> <p>DOCUMENT NUMBER: 13183I-001</p>	<p>Rev. No.: 0</p> <p>July 2013</p>

10 RECORDING & REPORTING



During the study, all hazards which are identified by the participants are minuted on the Recording Register APPENDIX 2.

Recommendations for remedial action are not normally part of the HAZID scope. The participants may however propose a solution or methods of reducing the risk if they believe answers are readily available. These comments should be regarded as expert advice from the HAZID participants and not definitive recommendations for action.

At the end of the study the Coordinator will produce a report that records the findings of the review. The report will highlight recommendations made by the participants that need to be considered for further studies, design modifications or require consultation with the regulating authorities.

11 HAZID CHECK LIST



The list below shows the major hazards identified from the previous HAZID studies. It is not intended to be totally exhaustive and can be enhanced as required.

	KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY	
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001	July 2013

APPENDIX 1 – HAZID CHECK LIST



Environmental Hazards

Generic Hazard	Potential Hazard	Expanders (Example of guideword application – not exclusive)
Natural	Climate Extremes	Temperature, waves, wind, dust, flooding, sandstorms, ice, blizzards, fog
	Lightning	Ignition Source
	Earthquakes	Pipeline Rupture
	Erosion	Ground slide, coastal, river
	Subsidence	Ground structure, foundations and reservoir depletion
Effect of the Facility on the Surroundings	Visual	Ruin skyline view
	Social-Economic	Overwhelms existing social infrastructure to the detriment of local population
	Local Impact	Close proximity to local areas of population or transportation corridors.
	Land Take	Removes countryside for industrial, residential or agricultural purposes
	Site Of Special Interest	Any site that contains environmentally significant flora or fauna, historic or religious sites
Discharges Leading to Damage	Continuous Plant Discharges to Air	Flares, vents, fugitive emissions, energy efficiency
	Continuous Plant Discharges to Water	Target/legislative requirements, drainage facilities, oil/water separation
	Continuous Plant Discharges to Land	Drainage, chemical storage
	Emergency / upset Discharges	Flares, vents, drainage, soil or groundwater contamination
	Contaminated Ground Facility Impact	Previous use or events Area minimisation, pipeline routing, environmental impact assessment
	Waste Disposal Options	Landfill, incineration, recycling
	Timing of Construction	Seasons, periods of environmental significance

	<p align="center">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>		
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY		Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001		July 2013



External Hazards

Generic Hazard	Potential Hazard	Expanders (Example of guideword application – not exclusive)
Infrastructure	Produce Emergency Response Plan	All associated activities to set up and implement an emergency response plan in the event of an incident
	Create / Enhance Local Infrastructure	Road, Rail, Air, Waterways, Utilities, Communications & Waste Management
	Transportation for Consumables	Food, Cleaning, Toiletries etc.
Man Made	Security Hazards	Internal and external security threats
	Terrorist Activity	Direct attack on installation leading to loss of containment.
	Social Instability	Riots, civil disturbance, strikes, military action, political unrest.
	Previous Site Contamination	Base line study, chemical, organic, radioactive.



	KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY	
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001	July 2013

Process Facility Hazards



Generic Hazard	Potential Hazard	Expanders (Example of guideword application – not exclusive)
Control Methods/ Philosophy	Manning / Operations Philosophy	Effect on design, effect on locality (Manned, unmanned, visited).
	Operations Concept	One train, x-trains, simplification.
	Maintenance Philosophy	Plant/train/equipment item, heavy lifting, access, override, bypass, commonality of equipment, transport.
	Control Philosophy	Appropriate technology, (DCS/local panels)
	Manning Levels	Accommodation, travel, support requirements. Consistency with operations and maintenance, etc philosophies.
	Emergency Response	Isolation, ESD philosophy, blow-down, flaring requirements.
	Concurrent Operations	Production, maintenance requirements.
	Start-up Shutdown	Modular or plant wide.
Fire and Explosion Hazards	Stored Flammables	Improper storage, operator error (release), defect, impact, fire (mitigation measures include: substitute non flammable, minimise and separate inventory).
	Sources of Ignition	Electricity, flares, sparks, hot surfaces (mitigation measures include: identify, remove, and separate).
	Equipment Layout	Confinement, escalation following release of explosive or flammable fluid (operator error, defect, impact process control failure, and corrosion), module layout/proximity, orientation of equipment, predominant wind direction (mitigation measures include: reduce degree of confinement, spacing based on consequence assessment, escalation barriers).
	Operational	Venting and Flaring, Relief & blow-down
	Fire Protection and Response	Active / passive insulation, fire / gas detection, blow-down / relief system philosophy, fire fighting facilities.
	Operator Protection	Means of escape, escape routes, evacuation systems, escape systems, rescue systems, PPE, communications, emergency response.

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>		
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY		Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001		July 2013

Generic Hazard	Potential Hazard	Expanders (Example of guideword application – not exclusive)
Process Hazards	Inventory	Excess hazardous material (mitigation measures include: minimise hazardous inventory, alternate processes and utility systems)
	Loss of Containment	Excessive process stress, impact (penetration by foreign object), process control failure, structural failure, erosion or corrosion (mitigation measures include: recognise and minimise process hazards during design, inherently safe plant, containment and recovery measures).
	Over Pressure	Offsite sources, process blockage, thermal expansion, connection of process to utility systems, chemical reaction
	Over / Under Temperature	Atmospheric conditions, blow-down, fire, hot surfaces, chemical reaction
	Excess / Zero Level	Overfill storage tanks, loss of function in separation vessels, blow-by to downstream vessels
	Wrong Composition / Phase	Offsite contamination, failure of separation process, buildup of wrong phase (sand, hydrates, etc), toxic substances
	Control Failure	on control failure will the plant shut down / depressurise safely
	Mechanical Failure	Vessel / Piping codes, fabrication procedure
	Impact	From lifting / vehicles
	Corrosion Mechanisms	
	Chemical Reaction	
	Common utility failure	
Utility Systems	System Types	<ul style="list-style-type: none"> • Firewater Systems • Fuel Gas • Heating Medium • Diesel Fuel • Power Supply • Steam • Drains • Inert Gas • Potable Water • Waste Storage and Treatment



	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>		
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY		Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001		July 2013

Generic Hazard	Potential Hazard	Expanders (Example of guideword application – not exclusive)
		<ul style="list-style-type: none"> • Chemical/fuel Storage • Sewerage
Maintenance Hazards	Considered Activities	<ul style="list-style-type: none"> • Access Requirements • Need to Override • Bypasses Required • Commonality of Equipment • Heavy Lifting Requirements • Transportation
Construction / Existing Facilities	Considered Activities	<ul style="list-style-type: none"> • Tie-ins (shutdown requirements) • Concurrent Operations • Reuse of Materials • Common Equipment Capacity • Interface Shutdown / Blow-down ESD • Skid Dimensions (weight / handling equipment) • Congestion • Existing Facilities • Mobilisation / Demobilisation • Soil Contamination

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>		
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p>		<p>Rev. No.: 0</p>
	<p>DOCUMENT NUMBER: 13183I-001</p>		<p>July 2013</p>

Health Hazards

Generic Hazard	Potential Hazard	Expanders (Example of guideword application – not exclusive)
Health Hazards	Direct Contact	<ul style="list-style-type: none"> Plants Insects Land Animals Marine Life
	Disease Hazards	Endemic diseases, infection, malarial mosquitoes, hygiene -personal and/or catering, contaminated water or foodstuff, social, e.g. AIDS, venereal disease, etc stagnant water, poor living conditions.
	Asphyxiation hazards	Asphyxiating atmospheres, failure to use appropriate PPE, vessel entry, working in confined spaces, smoke, exhaust.
	Carcinogenic	Chemicals in use. Asbestos
	Toxic	Hazardous atmosphere, asphyxiating atmosphere, chemicals in use. (e.g. Hydrogen Sulphide)
Health Hazards (Cont.)	Physical	Noise, radiation (ionising, e.g. radioactive scale or non ionising, e.g. flares, UV, sunlight), ergonomics.
	Mental	Shift patterns.
	Working Hazards	Diving, working in water, working at heights, hazardous equipment, hazardous surfaces, electricity.
	Transport	Excessive journeys, transportation type (rail, road, plane, helicopter), extreme weather, and quality of roads (mitigation measures include: effective journey management.



	KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY	
Project n° 3538-200	DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY	Rev. No.: 0
	DOCUMENT NUMBER: 13183I-001	July 2013

Project Implementation

Generic Hazard	Potential Hazard	Expanders (Example of guideword application – not exclusive)
Contracting Strategy	Prevailing influence	Stability and contractual conditions, contractor selection constraints
	Legislation	Governmental contracting requirements
	External Standards	Additional engineering and construction standards
	External Environmental Constraints	Governmental environmental requirements
Hazards Recognition and Management	Hazard Studies	Hazard and Operability studies, Quantitative and Qualitative Risk Assessments, Fire Risk Analysis
	HSE Case	Environmental Impact Assessments, etc
	Hazards Register	
	Project Controls	Quality assurance (change control, interdepartmental involvement and interfaces)
Contingency Planning	Geographical infrastructure Recovery Measures	Plant location, plant layout Medical support, fire fighting support, spill leak/clean-up support, security/military support, evacuation.
Competency	Level of Indigenous Training	Quality of local workforce and contractors
	Training Requirements	
	Level of Technology	

Reputation

Generic Hazard	Potential Hazard	Expanders (Example of guideword application – not exclusive)
Reputation	Financial Loss	
	Shut Down Project	
	Collapse Share Prices	

	<p style="text-align: center;">KPC Western Desert - EGYPT QASR COMPRESSION STATION PROJECT HAZID STUDY</p>		
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: PROCEDURE FOR HAZID STUDY</p>		<p>Rev. No.: 0</p>
	<p>DOCUMENT NUMBER: 13183I-001</p>		<p>July 2013</p>



APPENDIX 2 – HAZID RECORDING REGISTER

Separate Sheet will be used for:

- General Plant overview
- Gas Plant Process units hazard identifications
- Gas Plant Offsites units hazard identifications
- Gas Plant Utilities units hazard identifications

HSE HAZID	
Project Title	
Participants	
Review References	
Review Date	
NODE Description	

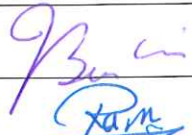

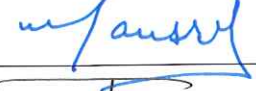



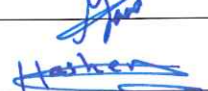
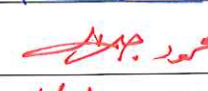
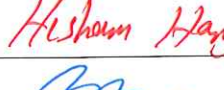

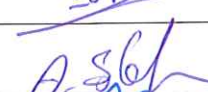


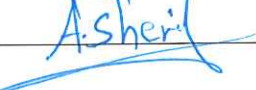


Action Number	Guideword	Threat	Consequence	Existing Safeguards	Ranking High, Medium, or Low	Action

	<p>KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0 July 2013</p>

ATTACHMENT B – ATTENDANCE LIST

KPC – QASR COMPRESSION PROJECT - HAZID STUDY

Attendance list


Session #	1		Day	9 / 7 / 2013
Name		Company	Discipline	Signature
FABRIZIO BUCCI	ICARO	Chairman		
Ramadan Ismail	Enppi	safety & L.P.		
Youssef Talaat	ENPPI	S&LP		
PETER HEIJ	KPC	Civil		
PEDRO MARCANO	KPC	Process		
Raafat Kafafy	Enppi	Process		
Mohamed Saad Eid	Enppi	Process		
Hafsem Hussien	Enppi	Process		
Mahmoud Galal	KPC	pipng		
Hesham Hany	KPC	Electrical		
John Stöpete	KPC	MECHANICAL		
Ibrahim Hamad	KPC	Process		
Ayman Sobh	KPC	Management		
Richard Catling	KPC	Project manager		
Hesham Tawfik	Enppi	PEM		
Ahmed Sherry	Enppi	PJM		

Attendance list

[illegible]

Attendance list

[illegible]

	<p>KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0 July 2013</p>

ATTACHMENT C – HAZID WORKSHEETS

Worksheet

Company: ENNPI

Location:

Facility: KPC - QASR Compression Project

PHA Method: HAZOP

PHA Type: Initial

Process:

Gas compression

File Description:

Date:

Process Description:

Chemicals:

Purpose:

Scope:

Objectives:

Project Notes:

Filters: No Filter Applied

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 1 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Natural

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVE	LIKEL	RANK	ACTION	BY
Climate extreme	1. Climate extreme Natural	1.1. high ambient temperature	1.1.1. possible damage to equipment	1.1.1.1. design criteria (DT 70 °C, including heat radiation)					
			1.1.2. loss of cooling capacity	1.1.2.1. air cooler are designed to handle ambient temperature up to 50 °C					
			1.1.3. slight reduction of turbine capacity and the compressor performance, leading to minor and temporary loss of production (if series mode is operated)						
			1.1.4. possible injuries to operators	1.1.4.1. existing HSE procedure to define proper PPE	1	C	m		
			1.1.5. possible HVAC damage for the camp	1.1.5.1. adequate design temperature or mechanical protection as per design basis					
		1.2. lower ambient temperature	1.2.1. possible freezing of FF water on monitor stand pipe					1. confirm that above ground FF devices are properly designed to avoid freezing condition	ENPPI
			1.2.2. possible injuries to operators	1.2.2.1. existing HSE procedure to define proper PPE	1	C	m		
			1.2.3. possible hydrate formation on aircoolers (compressor discharge), leading to plugging and possible over pressurization (scenario expected during turn down case)	1.2.3.1. control loop to control amount of air by the use of VSDS and pneumatic louvers 1.2.3.2. HP interlocks 1.2.3.3. PSV on compressors discharge	2	B	m		

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 2 of 21

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
Climate extreme (cont.)	1. Climate extreme Natural (cont.)	1.2. lower ambient temperature (cont.)	1.2.4. possible condensation of heavy HC in the fuel gas, leading to liquid carry over to the turbines and possible mechanical damage (economical impact)	1.2.4.1. fuel gas knockout drums (provided with high level interlock) and redundant (2x100%) fuel gas heaters	3	C	h	2. check the need for additional safeguard in PSVs/BDOs upstream pipes	ENNPI
			1.2.5. possible condensation of heavy HC in the fuel gas, leading to liquid carry over to flare system and possible minor environmental impact	1.2.5.1. existing flare knockout drum provided (for purging fuel gas) and new fuel gas knockout drum (for pilots)					
			1.2.6. possible water condensation/hydrate formation upstream the BDOs and PSVs, and possible reduction of availability	1.2.6.1. proper design (slope and no pocket)					
			1.2.7. possible hydrate formation on fuel gas system (unlikely event, process temperature will avoid hydrate formation of fuel gas in case of low ambient temperature)						
			1.2.8. wax formation in condensate instruments (level), leading to possible plugging and operational upset	1.2.8.1. level instrument of condensate section provided with electrical tracing				3. during the HAZOP, investigate possible hydrate formation for the black start up of fuel gas line	ENNPI
		1.3. excessive wind speed	1.3.1. possible damage to structure of condensate surge drum	1.3.1.1. design wind speed is 160 km/hr				4. operational procedures for air intakes filters cleaning to be issued	Enppi/KPC
		1.4. sand storm	1.4.1. sand entrance to air intakes lead to plugging of filters of HVAC/sand carry over to the machine lead to mechanical damage	1.4.1.1. proper filter selection to prevent sand carry over 1.4.1.2. proper orientation of air intakes against prevailing wind direction					
				1.4.1.3. provision of spare...					

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 3 of 21

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
Climate extreme (cont.)	1. Climate extreme Natural (cont.)	1.4. sand storm (cont.)	<p>1.4.1. sand entrance to air intakes lead to plugging of filters of HVAC/sand carry over to the machine lead to mechanical damage (cont.)</p> <p>1.4.2. sand entrance to air intakes lead to plugging of filters of instrument air compressor and possible loss of production/ and carry over to the machine lead to mechanical damage</p> <p>1.4.3. sand entrance to air intakes lead to plugging of filters gas turbine and possible loss of production/sand carry over to the machine lead to mechanical damage</p> <p>1.4.4. possible personnel injuries</p>	<p>...filter and relevant maintenance device</p> <p>1.4.2.1. proper filter selection to prevent sand carry over</p> <p>1.4.2.2. proper orientation of air intakes against prevailing wind direction</p> <p>1.4.2.3. provision of spare filter and relevant maintenance device</p> <p>1.4.3.1. self cleaning filters provided</p> <p>1.4.3.2. proper filter selection to prevent sand carry over</p> <p>1.4.3.3. proper orientation of air intakes against prevailing wind direction</p> <p>1.4.3.4. provision of spare filter and relevant maintenance device</p> <p>1.4.4.1. LER to protect personnel</p> <p>1.4.4.2. PPE</p>	1	D	H	4. operational procedures for air intakes filters cleaning to be issued (cont.)	
Lightning	2.	1.5. Fog/moisture 1.6. Lightning	<p>1.5.1. See sand storm but less critical</p> <p>1.6.1. possible damage to metallic structures/electrical equipments</p>	1.6.1.1. lightning protection system for buildings.				5. lightning protection system to be verified for both existing and new equipment and structure	ENNPI

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 4 of 21

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
Lightning (cont.)	2. (cont.)	1.6. Lightning (cont.)	1.6.2. possible ignition on atmospheric vent of compressor primary seal 1.6.3. possible ignition of atmospheric vent (purging) of gas turbine during start up/shutdown					6. possibility of ignition of compressor sealing vents to be investigated during HAZOP 7. possibility of ignition of turbine purging vents to be investigated during HAZOP	ENNPI ENNPI
Earthquakes	3. Earthquakes Natural	1.7. Earthquakes Natural (Zone 2A)	1.7.1. possible collapse of structures/equipment failure (loss of containment), leading to possible multiple fatalities and loss of production	1.7.1.1. structural (including buildings), mechanical and piping design	3	B	h		
Subsidence	4. Subsidence Natural	1.8. possible depletion of the reservoir	1.8.1. possible collapse of the unit		3	A	m	8. provide a dedicated study to evaluate possible reservoir depletion	KPC

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 5 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Effect of the surroundings

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVE	LIKEL	RANK	ACTION	BY
Visual	5. Visual Effect of the surroundings	1.9. no visual impact							
Social economic	6. Social economic Effect of the surroundings	1.10. N/A							
Local impact	7. Local impact Effect of the surroundings	1.11. N/A (closest city will be 80 KM)							
Land take	8. Land take Effect of the surroundings	1.12. N/A (closest city will be 80 KM)							
Site of special interest	9. Site of special interest Effect of the surroundings	1.13. N/A							

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 6 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Discharges leading to damage

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
Cont. plant disch. to air	10. Cont. plant disch. to air Discharges leading to damage	1.14. turbine exhaust	1.14.1. possible exceeding of national regulations limits					9. confirm with the supplier the rate/composition of emission is complying with the specifications/national regulations	ENPPI
			1.14.2. possible exposure of personnel to harmful substances					10. verify the need of in line gas analyser according to new national environmental regulations	ENPPI
		1.15. oxygen venting from nitrogen production unit	1.15.1. enrichment of oxygen in the vent exhaust and possible minor injuries in the surrounding					11. verify that O2 vent discharge from nitrogen package is routed in safe location outside the building	Enppi
			1.16. venting of equipments before maintenance (improper venting to atmosphere)					12. Refer To 41	
Cont.plant. disch.to water	11. Cont.plant.disch.to water Discharges leading to damage	1.16. venting of equipments before maintenance (improper venting to atmosphere)	1.16.1. massive flow of HC to the atmosphere and possibility of fire/explosion	1.16.1.1. operating maintenance manual	3	B	h	13. existing maintenance procedures to be adapted, including new equipment	ENPPI/KPC
			1.17. fugitive emission from flanges/gaskets	1.17.1. possible exposure of personnel to harmful/toxic materials				14. job safety analysis to be performed to investigate personnel exposure to harmful chemical agents (H2S, heavy HC and Hq)	KPC
Cont.pla...	12....	1.18. N/A	1.19. improper drain...	1.19.1. possible soil...				15. drainage philosophy for...	ENPPI

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 7 of 21

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
...nt.disch. to land	...Cont.plant.disch. to land Discharges leading to damage	...operation leading to discharge of liquid product to the ground	...contamination	...area				...new equipment to be verified and updating if required	
		1.20. washing activities	1.20.1. possible soil contamination by oil water	1.19.1.2. drains provided with valves and blinds 1.20.1.1. paved area and local sump 1.20.1.2. maintenance procedure provided by vendor				16. existing operational and maintenance procedures to be verified, including draining operation for new equipments 17. local sump capacity to be verified during HAZOP	ENNPI/KPC ENNPI
Emerg./upset discharges	13. Emerg./upset discharges Discharges leading to damage	1.21. intervention of ESD system for total plant de-pressurization	1.21.1. possible over pressure on the existing flare system/equipment resulting in mechanical damage and loss of containment	1.21.1.1. flare system has been verified according max flow rate in case of total plant de-pressurization (including additional load due to liquid vapourization in case of fire)	3	B	h		
			1.21.2. possible flow induced vibration on existing flare header leading to possible mechanical damage		3	B	h	18. flow induced vibration study for new and existing flare header to be performed	ENNPI
Contam.ground/fac.impact	14. Contam.ground/fac.impact Discharges leading to damage	1.22. N/A (no contamination found according to dedicated soil investigation)							
Waste disposal options	15. Waste disposal options Discharges leading to damage	1.23. production of waste during normal operation and maintenance	1.23.1. possible env. impact	1.23.1.1. existing procedures				19. Existing waste disposal procedures to be updated 20. Issue waste management plan for the new facility to be issued	KPC ENNPI
Timing of construction	16. Timing of construction Discharges leading to damage	1.24. N/A							

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 8 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Infrastructure

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVE	LIKEL	RANK	ACTION	BY
Prod.Emer q.Resp.Pla n	17. Prod.Emerq.Resp.Pla n Infrastructure	1.25. emergency situation in the plant	1.25.1. possible inadequate response	1.25.1.1. new fire fighting system				21. medical centre to be added in the new camp 22. evaluate to provide dedicated ambulance in Qasr facility	KPC KPC
Creat/Enh ance local infr.	18. Creat/Enhance local infr. Infrastructure	1.26. transportation of big size equipments	1.26.1. possible accidents/damage of equipments/delayed schedule	1.26.1.1. Enppi responsibility for equipment delivery including road verification					
Transp. for consumabl es	19. Transp. for consumables Infrastructure	1.27. N/A							

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 9 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Man Made

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVE	LIKEL	RANK	ACTION	BY
Security hazards	20. Security hazards Man Made	1.28. possible unauthorized access/sabotage in process unit	1.28.1. possible damage of equipments/loss of containments/injuries and fatalities	1.28.1.1. security fence				23. security plan/organization to be revised	KPC
Social instability	21. Social instability Man Made	1.29. external workers on strike and loss of supply for chemicals and materials	1.29.1. possible loss of production	1.29.1.1. stock for consumable materials					
Impact with vehicle	22. Impact with vehicle Man Made	1.30. chemical transportation by truck or presence of mobile cranes for maintenance	1.30.1. possible impact on equipment leading to mech. damage/possible injuries to operators	1.30.1.1. mechanical handling study 1.30.1.2. mechanical protection provided for critical equipments				24. existing safety policy for vehicle entrance to be reviewed	KPC

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 10 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Control methods - philosophy

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
Manning/operat. philos.	23. Manning/operat. philos. Control methods - philosophy	1.31. possible inadequate manning level	1.31.1. possible injuries/mistakes/loss of production					25. the operational/maintenance manning level shall be verified according to new configuration	KPC
Operations concept	24. Operations concept Control methods - philosophy	1.32. partial shut down of the compressor	1.32.1. possible loss of production	1.32.1.1. compressor spare available for series operation for HP compressor bundle (50%) 1.32.1.2. RAM study	3	B	h	26. evaluate sparing philosophy for LP compressor bundle	KPC
Control philosophy	25. Control philosophy Control methods - philosophy	1.33. lack of compatibility between existing DCS/ESD and new ones	1.33.1. loss of control / possible inadequate shutdown required	1.33.1.1. Enppi verified compatible systems					

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 11 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Fire and explosion hazard

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
Stored flammables	26. Stored flammables Fire and explosion hazard	1.34. possible loss of containment from condensate drum	1.34.1. fire and explosion and possible involvement of standby drum resulting in total shutdown of the plant	1.34.1.1. fire and gas detection system 1.34.1.2. fire fighting system 1.34.1.3. automatic depressurization 1.34.1.4. HSE philosophy including fire zones and fire proofing	3	B	H	27. evaluate proper additional mitigation measures to protect standby drum	Enppi
		1.35. possible loss of containment from closed drain drum	1.35.1. fire and explosion resulting in total shutdown of the plant	1.35.1.1. fire and gas detection system 1.35.1.2. fire fighting system 1.35.1.3. drum placed on a pit to prevent fire escalation	3	B	H		
Sources of ignition	27. Sources of ignition Fire and explosion hazard	1.36. static sparks, lightening, welding operation, hot spot, compressor start-up...etc	1.36.1. possible ignition of fire/explosion	1.36.1.1. earthing system for static electricity 1.36.1.2. lightening system for the building (refer to relevant parameter) 1.36.1.3. existing hot work permit procedures 1.36.1.4. hazardous area classification to proper devices selection	3	B	H	28. evaluate the possibility of ignition during compressor start-up during HAZOP 29. evaluate to provide anti static clothes and anti spark maintenance tools	Enppi/Solar
									KPC
Equipment lay-out	28. Equipment lay-out Fire and explosion hazard	1.37. release of flammable and fire /explosion	1.37.1. possible escalation of fire and explosion /possible involvement of equipment and buildings	1.37.1.1. proper equipment layout using GAP standard taking into consideration the prevailing wind	3	B	H		

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 12 of 21

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
Equipment lay-out (cont.)	28. Equipment lay-out Fire and explosion hazard (cont.)	1.37. release of flammable and fire /explosion (cont.)	1.37.1. possible escalation of fire and explosion /possible involvement of equipment and buildings (cont.)	1.37.1.2. fire and explosion study has been done			H (cont.)		
Fire protec. and response	29. Fire protec. and response Fire and explosion hazard	1.38. failure of fire fighting system on demand	1.38.1. escalation of fire and explosion	1.38.1.1. periodic testing of the fire fighting system 1.38.1.2. redundant fire fighting system and fail safe operation as per HSE philosophy 1.38.1.3. under ground fire fighting system	3	B	H		
		1.39. failure of fire and gas detection system where required	1.39.1. escalation of fire and explosion	1.39.1.1. confirmation by voting logic are implemented 1.39.1.2. SIL-3 certified for the logic solver and redundant final element	3	B	H		
Operator protection	30. Operator protection Fire and explosion hazard	1.40. emergency situation	1.40.1. injuries or fatalities	1.40.1.1. escape routes 1.40.1.2. muster points 1.40.1.3. emergency and evacuation plan 1.40.1.4. PPE 1.40.1.5. horns/beacons/manual call point and radio system 1.40.1.6. operation procedures consider emergency cases					

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 13 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Process hazards

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
Inventory	31. Inventory Process hazards	1.41. huge amount of residual flammable product involved in fire after total plant de-pressurization 1.42. huge amount of flammable product involved in fire (compressor section) 1.43. see fire hazard for condensate	1.41.1. possible escalation leading to fire enlargement/explosion 1.42.1. possible escalation leading to fire enlargement/explosion	1.41.1.1. redundant fire fighting system sized (4 hours) according to NFPA code 1.42.1.1. shut down system and automatic de-pressurization 1.42.1.2. redundant fire fighting system sized (4 hours) according to NFPA code 1.42.1.3. proper layout based on fire and explosion studies and GAP standard	3	B	h	30. evaluate if fire duration can exceed 4 hours according to historical experience and proper action to be defined accordingly (e.g: additional water supply)	KPC
Loss of containment	32. Loss of containment Process hazards	1.44. line random failure (corrosion, mech. stress, thermal stress, incorrect supporting, line/flange and vehicle impact)	1.44.1. loss of containment leading to possible fire/explosion	1.44.1.1. proper material selection 1.44.1.2. stress analysis 1.44.1.3. minimization of flanges 1.44.1.4. material acceptance procedure and hydraulic test	2	C	h	31. lines and flanges on new system to be included in the inspection plan	KPC/EN PPI
Over pressure/vacuum	33. Over pressure/vacuum Process hazards	1.45. pressure build up due control loop failure/human error	1.45.1. possible over pressurization and loss of containment	1.45.1.1. high pressure alarms, interlocks 1.45.1.2. PSV					
Over / under...	34. Over / under temperature...	1.46. depressurization scenario	1.46.1. temperature drop and possible material...	1.46.1.1. proper MDMT selection					

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 14 of 21

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
...temperature	...Process hazards	1.46. depressurization scenario (cont.)	...embrittlement and mechanical damage	1.46.1.2. impact test					
			1.46.2. possible temperature drop affecting the existing system	1.46.2.1. detailed flare and blow down study					
				1.46.2.2. flare dynamic study					
Excess/zero level	35. Excess/zero level Process hazards	1.47. see HAZOP							
Wrong composition/phase	36. Wrong composition/phase Process hazards	1.48. see HAZOP							
Control failure	37. Control failure Process hazards	1.49. malfunction of control loops	1.49.1. parameter deviation	1.49.1.1. fail safe philosophy					
Mechanical failure	38. Mechanical failure Process hazards	1.50. see HAZOP for equipments							
Impact	39. Impact Process hazards	1.51. see previous parameter							
Corrosion mechanism	40. Corrosion mechanism Process hazards	1.52. presence of H ₂ S/CO ₂ /chlorides	1.52.1. possible corrosion to piping and equipments leading to mech. failure	1.52.1.1. proper material selection					
Chemical reaction	41. Chemical reaction Process hazards	1.53. N/A							
Common utility failure	42. Common utility failure Process hazards	1.54. see utility parameter							

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 15 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Utility systems

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVE	LIKEL	RANK	ACTION	BY
System types	43. System types Utility systems	1.55. refer to fire hazards for unavailability of fire fighting network 1.56. loss of fuel gas supply 1.57. loss of heating medium not applicable 1.58. inadequate diesel fuel supply from existing unit 1.59. loss of power supply due to electrical network failure 1.60. loss of steam (N/A)	1.56.1. total plant shutdown and loss of production 1.56.2. loss of power supply 1.58.1. loss of level in diesel fuel daily tanks leading to inavailability of the relevant users (EDG and FF pumps) 1.59.1. total plant shutdown	1.56.1.1. sparing philosophy for fuel gas system 1.56.2.1. sparing philosophy for fuel gas system 1.56.2.2. power generator is dual fuel with automatic switching 1.56.2.3. EDG 1.59.1.1. FF system provided with diesel engine driven pumps 1.59.1.2. redundant conf. of electrical network 1.59.1.3. UPS for ESD, F&G and DCS 1.59.1.4. EDG to supply critical process loads to assure safe shutdown				32. adequate hydraulic study shall be developed for the new diesel supply line to new daily tanks	ENPPI

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 16 of 21

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
System types (cont.)	43. System types Utility svstems (cont.)	1.61. loss of instrument air	1.61.1. total plant shutdown and loss of production	1.61.1.1. fail safe philosophy for instrument air operated valves 1.61.1.2. redundant configuration of instrument air compressor (automatic switching over of the stand by machine) 1.61.1.3. instrument air reciever with 15 min. of hold up time					
		1.62. loss of nitrogen supply to compressor sealing system/purging	1.62.1. loss of nitrogen supply to compressor sealing system/purging will be discussed during the HAZOP						
		1.63.	1.63.1. loss of purging to cold vent and possible air entrance lead to potential of flammable mixtures	1.63.1.1. O2 analyzer in the cold vent					
		1.64. Loss of potable water	1.64.1. no significant impact						
		1.65. upset of sanitary sewer system	1.65.1. No significant impact						

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 17 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Maintenance hazards

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVE	LIKEL	RANK	ACTION	BY
Considered activities	44. Considered activities Maintenance hazards	1.66. Access Requirement	1.66.1. inadequate installation/removal of equipment and possible impact on structure/other equipment	1.66.1.1. Mechanical handling study 1.66.1.2. constructability study 1.66.1.3. work permit system					
		1.67. Overriding to interlocks	1.67.1. unavailability of interlocks after maintenance / startup	1.67.1.1. work permit system				33. operating /maintenance procedures to be developed including management interlock override 34. list of startup up overrides shall be included in startup guide 35. operability and maintainability study to be provided	KPC Enppi Enppi/KPC
		1.68. Bypass required for equipment/control valve/shutdown valves	1.68.1. possible shutdown of the unit to allow maintenance	1.68.1.1. sparing philosophy					
		1.69. Isolation during online maintenance	1.69.1. possible exposure of maintenance personnel to flammable/harmful substances	1.69.1.1. Project Isolation philosophy for new system 1.69.1.2. work permit system	2	B	M	36. isolation register to be updated	KPC

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 18 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Construction / existing facilities

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVE	LIKEL	RANK	ACTION	BY
Considered activities	45. Considered activities Construction / existing facilities	1.70. Tie-ins (shutdown requirement)	1.70.1. need to shutdown the existing facility during construction	1.70.1.1. Tie-in list which define the shutdown schedule					
		1.71. concurrent operation	1.71.1. possible interference between two or more construction activities leading to possible accident/injuries/delayed construction schedule					37. construction schedule to be developed	Enppi
			1.71.2. possible between construction activities and operation	1.71.2.1. work permit system				38. SIMOP study to be developed	KPC/Enppi
		1.72. reuse of existing materials (valves)	1.72.1. possible failure of the reused material					39. functional test to be performed for reused material	Enppi
		1.73. existing facility/mobilization/demobilization	1.73.1. possible damage of existing equipment/possible delayed construction	1.73.1.1. construction layout 1.73.1.2. constructability study 1.73.1.3. Radar mapping for under ground facilities					

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 19 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Health hazards

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
Direct contact	46. Direct contact Health hazards	1.74. possible injuries due to scorpions and snakes	1.74.1. possible injuries/fatalities	1.74.1.1. PPE 1.74.1.2. gravels				40. Refer To 21, adequate medical treatment to be provided	KPC
Disease hazard	47. Disease hazard Health hazards	1.75. improper food conservation causes possible disease	1.75.1. possible injuries/fatalities	1.75.1.1. proper facility for food conservation provided for the new camp				41. routine check to be provided	KPC
Asphyxiation hazards	48. Asphyxiation hazards Health hazards	1.76. loss of containment of nitrogen from nitrogen production package inside the relevant building	1.76.1. possible injuries/fatalities					42. Evaluate installing oxygen analyzer with low/high concentration alarm in utility building	Enppi
		1.77. confined space maintenance	1.77.1. possible injuries/fatalities	1.77.1.1. existing confined space work permit procedures					
Carcinogenic	49. Carcinogenic Health hazards	1.78. possible exposure to mercury during maintenance	1.78.1. possible injuries/fatalities over time					:Refer To 14	
Toxic	50. Toxic Health hazards	1.79. Refer To 1.17							
physical	51.	1.80. Noise level from machinery/vents	1.80.1. possible injuries to operators	1.80.1.1. noise study					
Mental	52.	1.81. No significant impact							
Working hazards	53.	1.82. no significant impact							
Transportation	54.	1.83. N/A							

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 20 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans

Parameter: Hazard recognition and management

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVE	LIKEL	RANK	ACTION	BY
Hazard studies	55. Hazard studies Hazard recognition and management	1.84. incomplete safety studies	1.84.1. possible hazards due to lack of required safe guards	1.84.1.1. deliverables list (EDIR) according to defining scope of work				43. ensure that safety review shall be performed during the follow-up evaluate possible risks in case of major/significant changes in the design	Enppi
		1.85. improper follow-up of HAZID/HAZOP/SIL studies recommendations	1.85.1. possible hazards due to lack of required safe guards	1.85.1.1. follow-up tracking register for each study					

Worksheet

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 21 of 21

Node: (1) Overall plant

Intention: The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

Drawings: The whole set of PFDs & plot plans



Parameter: Competency

Intention:

GW	DEVIATION	THREAT	CONSEQUENCES	EXISTING SAFEGUARDS	SEVERITY	LIKELIHOOD	RANK	ACTION	BY
Training requirements	56. Training requirements Competency	1.86. new unit operation (not familiar for personnel)	1.86.1. improper operation leading to loss of production/equipment damage/injuries	1.86.1.1. training program provided by enppi for process and maintenance personnel				44. update existing emergency and response plan and provide adequate training	KPC

Worksheet - Index

Node 1: Overall plant	1
Parameter: Natural	1
Parameter: Effect of the surroundings	5
Parameter: Discharges leading to damage	6
Parameter: Infrastructure	8
Parameter: Man Made	9
Parameter: Control methods - philosophy	10
Parameter: Fire and explosion hazard	11
Parameter: Process hazards	13
Parameter: Utility systems	15
Parameter: Maintenance hazards	17
Parameter: Construction / existing facilities	18
Parameter: Health hazards	19
Parameter: Hazard recognition and management	20
Parameter: Competency	21

	<p>KPC Western Desert - EGYPT QASR COMPRESSION PROJECT HAZID STUDY</p>	
<p>Project n° 3538-200</p>	<p>DOCUMENT TITLE: HAZID REPORT DOCUMENT NUMBER: 13183I-002</p>	<p>Rev. No.: 0 July 2013</p>

ATTACHMENT D – HAZID ACTION LIST

Action Items

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 1 of 6

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Natural

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
1. Climate extreme Natural	1.2. lower ambient temperature	1.2.1. possible freezing of FF water on monitor stand pipe	1. confirm that above ground FF devices are properly designed to avoid freezing condition	ENNPI
		1.2.6. possible water condensation/hydrate formation upstream the BDVs and PSVs, and possible reduction of availability	2. check the need for additional safeguard in PSVs/BDVs upstream pipes	ENNPI
		1.2.8. wax formation in condensate instruments (level), leading to possible plugging and operational upset	3. during the HAZOP, investigate possible hydrate formation for the black start up of fuel gas line	ENNPI
	1.4. sand storm	1.4.1. sand entrance to air intakes lead to plugging of filters of HVAC/sand carry over to the machine lead to mechanical damage	4. operational procedures for air intakes filters cleaning to be issued	Enppi/KPC
2.	1.6. Lightning	1.6.1. possible damage to metallic structures/electrical equipments	5. lightning protection system to be verified for both existing and new equipment and structure	ENNPI
		1.6.2. possible ignition on atmospheric vent of compressor primary seal	6. possibility of ignition of compressor sealing vents to be investigated during HAZOP	ENNPI
		1.6.3. possible ignition of atmospheric vent (purging) of gas turbine during start up/shutdown	7. possibility of ignition of turbine purging vents to be investigated during HAZOP	ENNPI
4. Subsidence Natural	1.8. possible depletion of the reservoir	1.8.1. possible collapse of the unit	8. provide a dedicated study to evaluate possible reservoir depletion	KPC

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Discharges leading to damage

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
10. Cont. plant disch. to air Discharges leading to damage	1.14. turbine exhaust	1.14.2. possible exposure of personnel to harmful substances	9. confirm with the supplier the rate/composition of emission is complying with the specifications/national regulations	ENNPI
			10. verify the need of in line gas analyser according to new national environmental regulations	ENNPI

Action Items

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 2 of 6

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Discharges leading to damage

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
10. Cont. plant disch. to air Discharges leading to damage (cont.)	1.15. oxygen venting from nitrogen production unit	1.15.1. enrichment of oxygen in the vent exhaust and possible minor injuries in the surrounding	11. verify that O2 vent discharge from nitrogen package is routed in safe location outside the building 12. Refer To 41	Enppi
	1.16. venting of equipments before maintenance (improper venting to atmosphere)	1.16.1. massive flow of HC to the atmosphere and possibility of fire/explosion	13. existing maintenance procedures to be adapted, including new equipment	ENPPI/KPC
	1.17. fugitive emission from flanges/gaskets	1.17.1. possible exposure of personnel to harmful/toxic materials	14. job safety analysis to be performed to investigate personnel exposure to harmful chemical agents (H2S, heavy HC and Hg)	KPC
12. Cont.plant.disch. to land Discharges leading to damage	1.19. improper drain operation leading to discharge of liquid product to the ground	1.19.1. possible soil contamination	15. drainage philosophy for new equipment to be verified and updating if required	ENPPI
			16. existing operational and maintenance procedures to be verified, including draining operation for new equipments	ENPPI/KPC
	1.20. washing activities	1.20.1. possible soil contamination by oil water	17. local sump capacity to be verified during HAZOP	ENPPI
13. Emerg./upset discharges Discharges leading to damage	1.21. intervention of ESD system for total plant de-pressurization	1.21.2. possible flow induced vibration on existing flare header leading to possible mechanical damage	18. flow induced vibration study for new and existing flare header to be performed	ENPPI
15. Waste disposal options Discharges leading to damage	1.23. production of waste during normal operation and maintenance	1.23.1. possible env. impact	19. Existing waste disposal procedures to be updated	KPC
			20. Issue waste management plan for the new facility to be issued	ENPPI

Action Items

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 3 of 6

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Infrastructure

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
17. Prod.Emerg.Resp.Plan Infrastructure	1.25. emergency situation in the plant	1.25.1. possible inadequate response	21. medical centre to be added in the new camp 22. evaluate to provide dedicated ambulance in Qasr facility	KPC KPC

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Man Made

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
20. Security hazards Man Made	1.28. possible unauthorized access/sabotage in process unit	1.28.1. possible damage of equipments/loss of containments/injuries and fatalities	23. security plan/organization to be revised	KPC
22. Impact with vehicle Man Made	1.30. chemical transportation by truck or presence of mobile cranes for maintenance	1.30.1. possible impact on equipment leading to mech. damage/possible injuries to operators	24. existing safety policy for vehicle entrance to be reviewed	KPC

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Control methods - philosophy

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
23. Manning/operat. philos. Control methods - philosophy	1.31. possible inadequate manning level	1.31.1. possible injuries/mistakes/loss of production	25. the operational/maintenance manning level shall be verified according to new configuration	KPC
24. Operations concept Control methods - philosophy	1.32. partial shut down of the compressor	1.32.1. possible loss of production	26. evaluate sparing philosophy for LP compressor bundle	KPC

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Fire and explosion hazard

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
26. Stored flammables Fire and explosion hazard	1.34. possible loss of containment from condensate drum	1.34.1. fire and explosion and possible involvement of standby drum resulting in total shutdown of the plant	27. evaluate proper additional mitigation measures to protect standby drum	Enppi
27. Sources of ignition Fire and explosion hazard	1.36. static sparks, lightning, welding operation, hot spot, compressor start- ...	1.36.1. possible ignition of fire/explosion	28. evaluate the possibility of ignition during compressor start-up during HAZOP	Enppi/Solar

Action Items

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 4 of 6

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Fire and explosion hazard

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
27. Sources of ignition Fire and explosion hazard (cont.)	...up...etc	1.36.1. possible ignition of fire/explosion (cont.)	29. evaluate to provide anti static clothes and anti spark maintenance tools	KPC

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Process hazards

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
31. Inventory Process hazards	1.41. huge amount of residual flammable product involved in fire after total plant de-pressurization	1.41.1. possible escalation leading to fire enlargement/explosion	30. evaluate if fire duration can exceed 4 hours according to historical experience and proper action to be defined accordingly (e.g: additional water supply)	KPC
32. Loss of containment Process hazards	1.44. line random failure (corrosion, mech. stress, thermal stress, incorrect supporting, line/flange and vehicle impact)	1.44.1. loss of containment leading to possible fire/explosion	31. lines and flanges on new system to be included in the inspection plan	KPC/ENNPI

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Utility systems

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
43. System types Utility systems	1.58. inadequate diesel fuel supply from existing unit	1.58.1. loss of level in diesel fuel daily tanks leading to inavailability of the relevant users (EDG and FF pumps)	32. adequate hydraulic study shall be developed for the new diesel supply line to new daily tanks	ENNPI

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Maintenance hazards

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
44. Considered activities Maintenance hazards	1.67. Overriding to interlocks	1.67.1. unavailability of interlocks after maintenance / startup	33. operating /maintenance procedures to be developed including management interlock override	KPC
			34. list of startup up overrides shall be included in startup guide	Enppi
			35. operability and maintainability study to be ...	Enppi/KPC

Action Items

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 5 of 6

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Maintenance hazards

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
44. Considered activities Maintenance hazards (cont.)	1.67. Overriding to interlocks (cont.)	1.67.1. unavailability of interlocks after maintenance / startup (cont.)	...provided	KPC
	1.69. Isolation during online maintenance	1.69.1. possible exposure of maintenance personnel to flammable/harmful substances	36. isolation register to be updated	

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Construction / existing facilities

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
45. Considered activities Construction / existing facilities	1.71. concurrent operation	1.71.1. possible interference between two or more construction activities leading to possible accident/injuries/delayed construction schedule	37. construction schedule to be developed	Enppi
		1.71.2. possible between construction activities and operation	38. SIMOP study to be developed	KPC/Enppi
	1.72. reuse of existing materials (valves)	1.72.1. possible failure of the reused material	39. functional test to be performed for reused material	Enppi

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Health hazards

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
46. Direct contact Health hazards	1.74. possible injuries due to scorpions and snakes	1.74.1. possible injuries/fatalities	40. Refer To 21, adequate medical treatment to be provided	KPC
47. Disease hazard Health hazards	1.75. improper food conservation causes possible disease	1.75.1. possible injuries/fatalities	41. routine check to be provided	KPC
48. Asphyxiation hazards Health hazards	1.76. loss of containment of nitrogen from nitrogen production package inside the relevant building	1.76.1. possible injuries/fatalities	42. Evaluate installing oxygen analyzer with low/high concentration alarm in utility building	Enppi

Action Items

Company: ENNPI
Facility: KPC - QASR Compression Project

Page: 6 of 6

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Hazard recognition and management

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
55. Hazard studies Hazard recognition and management	1.84. incomplete safety studies	1.84.1. posible hazards due to lake of required safe guards	43. ensure that safety review shall be performed during the follow-up evaluate possible risks in case of major/significant changes in the design	Enppi

Node: (1) Overall plant
Drawings: The whole set of PFDs & plot plans
Parameter: Competency

DEVIATION	THREAT	CONSEQUENCES	ACTION	BY
56. Training requirements Competency	1.86. new unit operation (not familiar for personnel)	1.86.1. improper operation leading to loss of production/equipment damage/injuries	44. update existing emergency and response plan and provide adequate training	KPC